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BIOLOGY OF SOME COLEOPTERA OF THE FAMILIES COLYDIIDAE AND BOTHRIDERIDAE.

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Several species of the family Colydiidae which show very different larval structures and habits have been reared by the writer. These forms were grouped by the older systematists in the family Colydiidae which included the Bothrideridae, but the latter have since been separated as a distinct family. An analysis of the available larvae substantiates the erection of the forms allied to *Bothrideres* to family rank. In fact, the two types, as represented by the last named genus and *Aulonium* have very few fundamental characters in common. The material here described is from the U. S. National Museum and Forest Insects Collections.

The larvae of some of the European species[1] of these families have been described but none of the North American forms. In fact, several records of food habits constitute the entire pub-

[1] *Aulonium trisulcum* Geoffr. Westwood-Trans. Ento. Soc. London, 1839.

Aulonium ruficorne Oliv. (*A. bicolor* Herbst). Perris-Insectes du Pin Maritime, 1853.

Aglenus brunneus Gyll. Rey-Ann. Soc. Linn., 1887.

Cerylon histeroides F. Erichson-Naturgeschichte der Insecten Deutchlands-Erste Altheilung, Coleoptera, Berlin, 1848.

Colobicus marginatus Latr. Perris-Larves des Coleopteres. 1877.

Colydium filiforme F. Ratzeburg-DieForstinsecten. 1837.

Ditoma crenata Fabr. Perris-Insectes du Pin Maritime, 1853.

Synchita humeralis F (*Ditoma juglandis* F.). Nordlinger Stettin. Ento. Zeit. p. 256, Vol. 9, 1848.

Endophloeus markovichiana Pill. (*spinulosus* Latr.). Perris—Larves des Coleopteres, 1877.

Langelandia anopthalma Aube. Perris—Larves des Coleopteres, 1877.

Orthocircus clavicornips (*muticus*) L. Rupertsberger—Verhdl. Zoo. Bot. Ges. Wien. p. 7–28, 1872.

Synchitodes crenatus Herbst. Perris—Insectes du Pin Maritime, 1853.

lished data on our fauna. Drury (1878)[1] published a brief note on two species of Bothrideridae, *Bothrideres geminatus* Say. and *Erotybothris exaratus* Melsh., stating that they spin cocoons. Stebbing (1914)[2] likewise calls attention to this fact (on an Indian species) and states that the larvae are predaceous.

The described European species all belong to the Colydiidae. In several cases it is noted that the larvae are predaceous but all species here described and reared are purely feeders on decaying vegetable matter. It is possible that the genus *Colydium* may be predaceous basing the supposition on the habits of the adult.

COLYDIIDAE.

In the family Colydiidae the genera *Aulonium*, *Ditoma*, *Phloeonemus*, *Nematidium* and *Synchita* have been studied. They may be characterized as follows:

Elongate, cylindrical to subcylindrical; legs well developed, five jointed coxae conical, well separated, tarsi claw-like (no tarsal claws); head extended from prothorax, nearly hypognathous, labrum well defined, mouth parts deeply retracted; hypopharynx, which is lightly chitinized, strongly connected by arm of hypostoma; inner side of stipes free to near base; cardo transverse, obliquely articulating with stipes; maxillary sclerite large, cushioned; gula well defined, forming a strong support between ventral epicranial halves; mandibles having well developed molar part, bidentate at apex and no retinaculum; antennae contiguous to mouth frame, three-jointed (except Nematidium) with supplementary joint; pre and posthypopleural chitinization of thorax very narrow; presternum of prothorax large, subtriangular; presternal fold of meso- and metathorax well defined; cerci of two rigid recurved spines, usually with a sac-like depression between; tenth segment wart-like, ventral; spiracles bifore, mesothoracic on presternal ring.

TAXONOMIC POSITION OF THE COLYDIIDAE.[3]

The larvae of the Colydiidae must be regarded as belonging to the so-called Heteromerous series. In fact, it is difficult to find characters that will separate them from certain of these families. The retraction and structure of the mouth parts is common to a large series of families beginning with the Cucujidae and Cryptophagidae. It appears in the Mycetophagidae, Byturidae and all the Heteromerous families except the Mordellidae,

[1] Drury, Charles. Canadian Ento. Vol X, p. 210, 1878.

[2] Indian Forest Insects. London, 1914—E. P. Stebbing, p. 334.

[3] The following taxonomic discussion is based on a joint study of the characterization of Coleopterous larvae undertaken by A. G. Boving and F. C. Craighead.

Meloidae and Rhipiceridae. These mouth parts are characterized by the deep retraction, the large maxillary sclerite and the greater portion of stipes being free, *i. e.*, the inner margin is free from both mentum and maxillary sclerite to near base. This allows considerable lateral and forward movement of the maxillae. However, the graduation through larval characters from so-called Clavicorn forms to Heteromerous types is so gradual that the recognition of the latter series cannot be substantiated by the larvae.

Many of the larger Heteromera have a strongly chitinized hypopharynx. This is not developed in any of the Colydiidae nor likewise in certain Heteromerous families, especially the smaller species. From the Cucujidae and Cryptophagidae, the Colydiidae can be distinguished by not having falciform lacinia, from the Mycetophagidae by the distinct triangular presternum and from other related families by the cercal structures. These two curved cerci, with a sac-like depression between, occur in certain Heteromera having the chitinous hypopharynx, but these seldom have the bifore spiracle.

Description of the Larvae and Pupae.

Aulonium tuberculatum Lec.

Larva.—Form elongate, cylindrical, slightly wider along 5th and 6th segments; integument smooth, lightly chitinized, though somewhat heavier on the last terga; sparsely haired.

Head subcircular, slightly depressed, projecting; occipital foramen posterior, epicranial halves ventrally separated by a semi-chitinous gular region; ventral mouth parts deeply retracted, hypostomal margins more heavily chitinized and having a well-defined hypostomal bracon connected with hypopharynx; the latter having a transverse narrow chitinization; clypeus and labrum distinct, the latter transverse; front broadly fusiform, nearly bisecting epicranial halves, sutures not complete anteriorly; antennae laterally inserted, three-jointed; first joint transverse, second barrel-shaped, bearing a distinct supplementary joint, third elongate, slender; ocelli five behind base of antennae, grouped in sets of three and two. Mandibles, grinding type, having well developed molar part bearing fine asperities on the inner face, apex bifid and cutting edge bearing two obtuse teeth; ventral mouth parts but slightly chitinized, maxillary sclerite large cushioned; cardo transverse, chitinized portion transversely triangular; lacinia broad truncate at apex, bearing short chitinous points on inner margin, maxillary palpi three-jointed on a lobe-like palpifer; submentum hour-glass shaped; mentum barrel-shaped; stipes transversely fused; labial palpi two-jointed; apical joint cylindrical; ligula broad oval.

Protergum about as wide as long, not differentiated from epipleurum at sides; presternal plate of prothorax elliptical, distinct; presternal ring well-defined on mesothorax and metathorax, former bearing spiracle; hypopleural chitinizations very narrow line-like, the prehypopleural stronger; hypopleural suture distinct, bearing condyle of coxa. Legs strong, about as long as width of body, five-jointed, coxa large, conical widely separated; trochanter short, femur about equaling tibia, tarsus shaped as a flattened claw.

Segments uniformly chitinized, or slightly heavier on tergum which is entire and bearing anteriorly a transverse, curved, dentate carina; epipleurum slightly protuberant; hypopleurum less so; sternum laterally bearing two faint longitudinal impressions below coxal lobe. Ninth abdominal segment terminal, with tergum heavily chitinized and bearing two strongly recurved unjointed cerci, the latter having between a deep cylindrical pit; tenth wart-like, ventral, having several small projecting papillae. Spiracles annular, bifore, a little larger than ocelli.

Pupa.—Form as *Ditoma,* head concealed beneath prothorax; latter elongate, rectangular bearing four tubercles on anterior margin, the median two larger, lateral margins multidentate, with setiferous teeth; scutellum of mesothorax oval; abdominal terga bearing one or two lateral setiferous papillae and also one on epipleurum; last tergum bearing two strongly recurved chitinous points.

Described from specimens, Hopk. U. S. No. 11872y, collected by the writer at East Falls Church, Va., under bark of dead pine log containing developing Scolytid larvae.

They feed under the bark of a variety of coniferous trees and are usually found after the inner bark has been considerably macerated by other larvae. Very young larvae have been collected and reared in confinement and they feed entirely on this vegetable tissue. The pupal cell consists of a small oval enlargement in this macerated bark.

Ditoma crenata F.[1]

Larva.—Similar to *Aulonium tuberculatum* in all essential characters, but the body is slightly more depressed, the terga lack the transverse carina of asperities, and the ninth tergum is not heavily chitinized, but bears two slender, recurved cerci and a shallow pit between them. The largest specimen measures $5^1/_2$ mm. long.

Pupa.—Similar to *A. tuberculatum,* except by the arrangements of papillae on margin of pronotum, and cerci not strongly recurved.

Described from two larvae and one pupa in the U. S. N. M. collection. One larva from Dr. Meinert from the Zoo. Mus., Copenhagen, Denmark; one larva and pupa from E. C. Rosenberg, Copenhagen, Denmark. The latter were collected under

[1] This larva has been described by Perris—Insects du Pin Maritime, 1853.

the bark of *Fagus silvaticus*, September 30, 1895, Dyrehaven, Denmark.

Phloeonemus catenulatus Horn.

Larva.—Similar to *Aulonium* but slightly more depressed; antennae and palpi more slender; mandibles having brush of hairs on molar part; carina on terga less pronounced and more regular; eighth and ninth terga not strongly chitinized, latter bearing cerci as figure; spiracles having bifore lobes much larger.

Described from specimens in the U. S. Nat. Museum, labeled 587 Beeville, Texas, November, 1895. These were collected by E. A. Schwartz in the gum exuding from scars on mesquite trees.

Synchita fuliginosa Melsh.

Larva.—Form elongate, subcylindrical, having slight dorsal and ventral ampullar protuberances, each bearing a lateral and transverse impression; maximum length, 6 mm.; integument white, not chitinized, sparsely clothed with long, slender hairs. Ninth tergum projecting in a single recurved cercus bifurcated at the apex; pre- and post-hypopleural chitinizations of thorax line-like and very faint; otherwise essentially as *Aulonium* except that the terga do not bear the transverse carina.

Described from specimens, Hopk. U. S. No. 9709.

These larvae have always been found under bark associated with fungous growth. They are very common in cankers of the chestnut bark disease (*Endothia*) feeding on the deteriorating bark or fungus mycelium. The adults eat the conidial threads.

Synchita sp.

Larva.—Distinguished from *S. fuliginosa* by the more slender and more strongly recurved cerci.

Pupa.—Essentially as *Ditoma* but having the pronotum wider in front and regularly beset around the anterior and lateral margins with small finely setose papillae. Setae of body very fine; last tergum bearing two conical, widely separated, erect, projecting, but slightly chitinized points.

Descriptions from specimens, Hopk. U. S. No. 10083t. They were collected at East Falls Church, Va., under the bark of a dead spruce log, associated with a white mouldy growth. The adult has not been specifically determined.

Nematidium filliforme Lec.

Larva.—Form very elongate cylindrical; largest specimen 12 mm. long, by 1 mm. wide; integument thin, rather thickly beset with short stiff hairs.

Head elongate-oval, strongly chitinized; labrum circular; front triangular;

entirely distinct; antennae short, two-jointed with supplementary joint; (basal joint possibly retracted); no ocelli; mandible obtusely bidentate, cutting edge bearing two obtuse teeth, but molar part less pronounced than in *Aulonium;* ventral mouth parts less deeply retracted than *Aulonium*, cardo more perpendicular and oval, mentum and stipes more heavily chitinized; lacinia cylindrical; only last joint of labial palpi distinct, this cylindrical.

Legs more robust and shorter than in *Aulonium*, hairs short, setose. Thoracic and abdominal terga entire; ninth segment relatively short, bearing two long recurved chitinous cerci with no pit or carina between; tenth wart-like, ventral. Spiracles annular-bifore, the spiracular tubes very small.

Pupa.—Form more slender than in *Aulonium*, protergum about twice as long as wide, anterior and lateral margin bearing setigerous papillae; scutellum less pronounced; lateral margins of terga bearing two setose papillae, epipleurum one; last segment having two widely separated, acute, erect, chitinous points.

Described from specimens in the U. S. Nat. Museum, labeled 2197, Ft. Capron, Florida. These were collected by H. G. Hubbard.

Monoedus Lec.

Larva.—Form and general character similar to *Aulonium* from which it differs in lacking the heavy chitinization of the cercal plate and the cerci are less strongly recurved. A very faint carina extends across the anterior margin of the mesothorax and metathorax. Tip of lacinia rounded, not beaked, inner apex bearing curved spines, last joint of maxillary palpus cylindrical, obtuse, scarcely longer than second; anterior margin of clypeus regularly curved; last joint of antennae cylindrical, slightly longer than penultimate; molar surface of mandible beset with much coarser teeth.

Described from a single specimen in the U. S. N. Museum Collection. This larva was not reared but collected in the pith of stems of *Metostelma* on the branches of which the adults were very abundant. Homestead, Fla., February 24, 1919. H. S. Barber.

If this larva is properly associated with *Monoedus* the genus should certainly be placed in the Colydiidae.

Bothrideridae.

In the family Bothrideridae the larvae of *Bothrideres*, *Deretaphrus* and *Lithophanus* have been studied. They may be characterized as follows:

White, fleshy, fusiform, having very thin integument; legs short, five-jointed, coxae very widely separated, tarsi claw-like (no tarsal claws); head

extended from prothorax, epignathous; labrum present; mouth parts deeply retracted, fleshy; cardo large, cushioned; maxillary sclerite distinctly cushioned; ligula long, obtusely conical and exceeding in length the labial palpi; gula elongate, thinly chitinized mandibles without molar structure, apex bidentate, retinaculum present; antennae contiguous to mouth frame, two-or-three-jointed, the basal joint bearing a large dilated supplementary joint; no thoracic hypopleural chitinization; presternum of prothorax triangular; presternal fold of mesothorax and metathorax very broad; cerci, when present, of two recurved spines; ninth abdominal segment terminal; tenth wart-like; spiracles annuliform, mesothoracic, on presternal ring.

TAXONOMIC POSITION OF THE BOTHRIDERIDAE.[1]

The relationships of this family are problematical. As stated in the introduction they are certainly quite distinct from any of the Colydiidae here described. The peculiar form and habits tend to emphasize this distinction,—possibly too emphatically—and give a suggestion of Clerid or Trogositid affinities. For the present, however, it is probably more natural to regard them as a specialized development from some of the Colydids with reduced molar structure. The parasitic nature of these larvae does not necessarily demand a morphological change of the fundamental head structures. This is well illustrated by the parasitic genera placed in the Cucujidae, *Catogenus* and *Scalidia*, where we find identical form and habits but radically different head structures.

Description of the Larva and Pupa.

Deretaphrus oregonensis Horn.

Larva.—Fleshy, fusiform, widest about 5th and 6th abdominal segments; integument thin, practically glabrous; maximum length 14 mm.

Head subglobular, epignathous, extended; occipital foramen posterior; epicranial halves ventrally separated by thin sub-rectangular gular region; ventral mouth parts retracted; clypeus and labrum distinct, both roundly transverse, latter twice as wide as long, having anterior margin sinuate; no frontal or epicranial sutures; antennae laterally inserted; very small, two-or-three-jointed, basal joints bearing a long, distinact appendage, 2d and 3d joints subequal; no ocelli; mandible triangular, without molar structure, bifid at apex and having a large retinaculum; ventral mouth parts fleshy, weak, retracted about half the depth of the head; margins of hypostoma slightly chitinized, maxillary sclerite distinct, cushioned; cardo large, fleshy, with a triangular chitinization; inner margin of stipes chitinized; lacinia broad, fleshy; no galea; maxillary palpi three-jointed; 3d joint longest; no palpifer; submentum large trapezoidal; mentum barrel-shaped; ligula long, conical, greatly exceeding labial palpi; palpi two-jointed.

[1] The following taxonomic discussion is based on a joint study of the characterization of Coleopterous larvae undertaken by A. G. Boving and F. C. Craighead.

Thoracic segments about equal in length, metathorax widest; no distinct areas, except band-like presternal fold, which in the prothorax bears two small chitinous spots; coxal protuberance lateral, strongly projecting. Legs short, conical, weak, widely separated, consisting of five joints; tarsus claw-like-, appendiculate at base.

Abdomen swollen, and not distinctly marked into areas; ninth bearing two chitinous recurved hooks or cerci; tenth wart-like, terminal. Spiracles annuliform, peritreme circular, rather strongly chitinized, thoracic spiracle on presternal ring of meso thorax; eight abdominal spiracles.

Pupa.—Form of adult; head concealed beneath prothorax, latter rectangular, sides rounded; abdominal terga bearing a few stiff hairs as figure; no cerci.

Described from specimen, Hopk. U. S. No. 10651v.

This specimen was taken by the writer at Giant Forest, California, June 29, 1918, in the pupal cells of *Asemum atrum* in a dead Jeffrey pine. It could not be determined when the larvae attack the host but the *Asemum* larvae had constructed their pupal cells and were full grown before being killed.

Lithophanus succineus Pasc.

This species has cerci similar to *Deretaphrus* and the mandible is provided with a retinaculum, which is very slender and projects posteriorly. The last joint of the antennae is rounded at the apex and the supplementary joint is conical. It measures about 8 mm. in length.

Larvae of this species have not been definitely associated with the adults. A large series of adults were reared from a small piece of *Acacia*, girdled by *Oncideres* (Hopk. U. S. No. 15128) which Mr. T. E. Snyder sent the writer from Brownsville, Texas. In the U. S. N. Museum Collection a single specimen, described above, was found, collected by Mr. H. S. Barber, in *Parkinsonia*, at the same place. Since it differs both from *Deretaphrus* and *Bothrideres* it is tentatively associated with this name.

The reared specimens were predaceous on several species of Cerambycids, *Achryson concolor* Lec., *Ibidion townsendi* Linell and *Obrium maculatum* (*Phyton pallidum*). The cocoons were found under the bark in the larval mines of these hosts.

Bothrideres geminatus Say.

Larva.—Similar in form and general structure to *Deretaphrus oregonensis* from which it differs in lacking the cerci and the retinaculum of the mandible; the lacinia is more lanceolate at the apex. Specimens at hand do not exceed 5 mm. in length.

Described from Hopk. U. S. Nos. 2843e, 3838, 10083j, 12600, and Hopk. W. Va. Nos. 6977e and 7177. The specimens were collected by Dr. A. D. Hopkins, Mr. W. S. Fiske, J. N. Knull and the writer. They were all predaceous on Coleopterous larvae or pupae, in each case killing the host after it had completed its larval mine. The hosts were *Saperda candida* in apple; *Saperda discoidea* in hickory and a *Chariessa* pupa in persimmon.

Specimens 12600 were taken under the bark of *Quercus* sp. sent to Washington by M. Chrisman from Sabino Canyon, Arizona. Several larvae were found inside a single pupa of *Chrysobothris*. They were isolated March 20, 1914, and soon formed cocoons on the sides of glass vial containers. Adults emerged August 15. In this case the writer believes they were internally parasitic.

Bothrideres cactophagi Schwarz.

No larvae of this species have been seen but Mr. H. G. Hubbard recorded some interesting notes on the habits. He found[1] it in large numbers in the cocoons of the cactus weevil (*Cactophagus validus*) on which it is undoubtedly parasitic. Mr. E. A. Schwartz tells me it does not make a cocoon as *B. geminatus*.

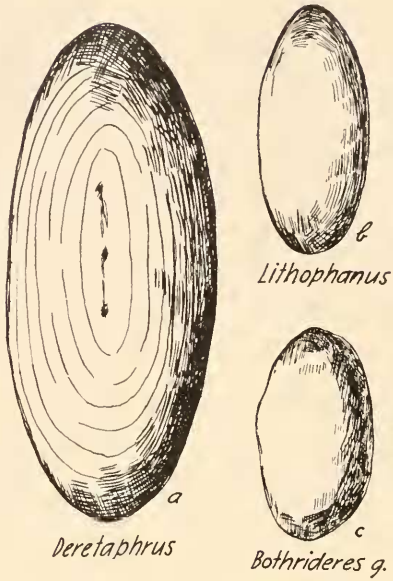
Cocoons of Bothrideridae.

Three species here described all pupate in cocoons. These are made by the full-grown larvae. They are probably of a chitinous material but whether secreted from the buccal opening or from anal glands as do the species of *Donacia*[2] has not been determined at present. The cocoons of *Bothrideres* and *Lithophanus* have a silky appearance and webby texture as though composed of minute threads, while that of *Deretaphrus* is of considerably heavier material and uniform texture. On this last cocoon the concentric arrangement of the exterior shows how it is built. They are all attached to the wood on the side of the larval mine of the host.

The cocoon of *Deretaphrus* measures 14 mm. in length by 4 mm. in width. *Lithophanus* is 6 mm. long by 3 mm. wide. *Bothrideres* is 15 mm. long by $3^1/_2$ wide. That of *Deretaphrus* and *Lithophanus* are elongate oval, while *Bothrideres* is broadly oval and quite depressed.

[1] Supplement to Psyche; Insects of the Giant Cactus.—May, 1899, pages 8 and 10.

[2] Bøving, Adam G.—Bidrag til kundskaben om donaciin-larvernes naturhistorie. København, H. Hagerups forlag 1906.

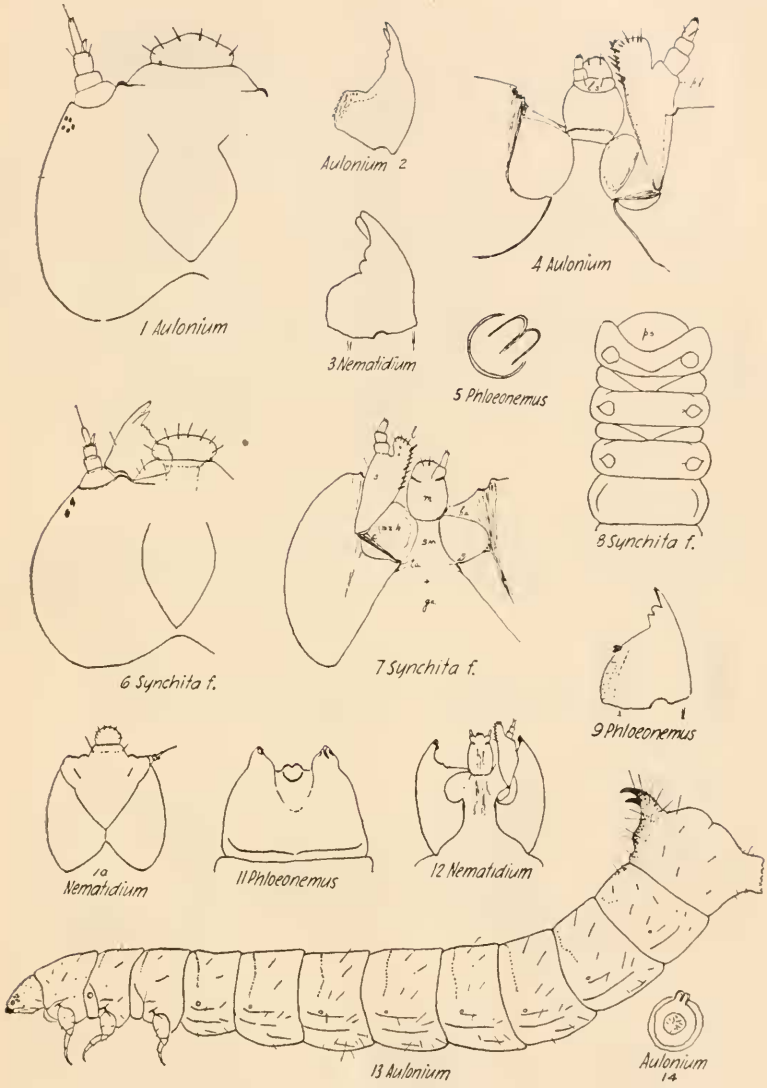


Cocoons of Bothrideridae—*a*, Deretaphrus; *b*, Lithophanus; *c*, Bothrideres g.

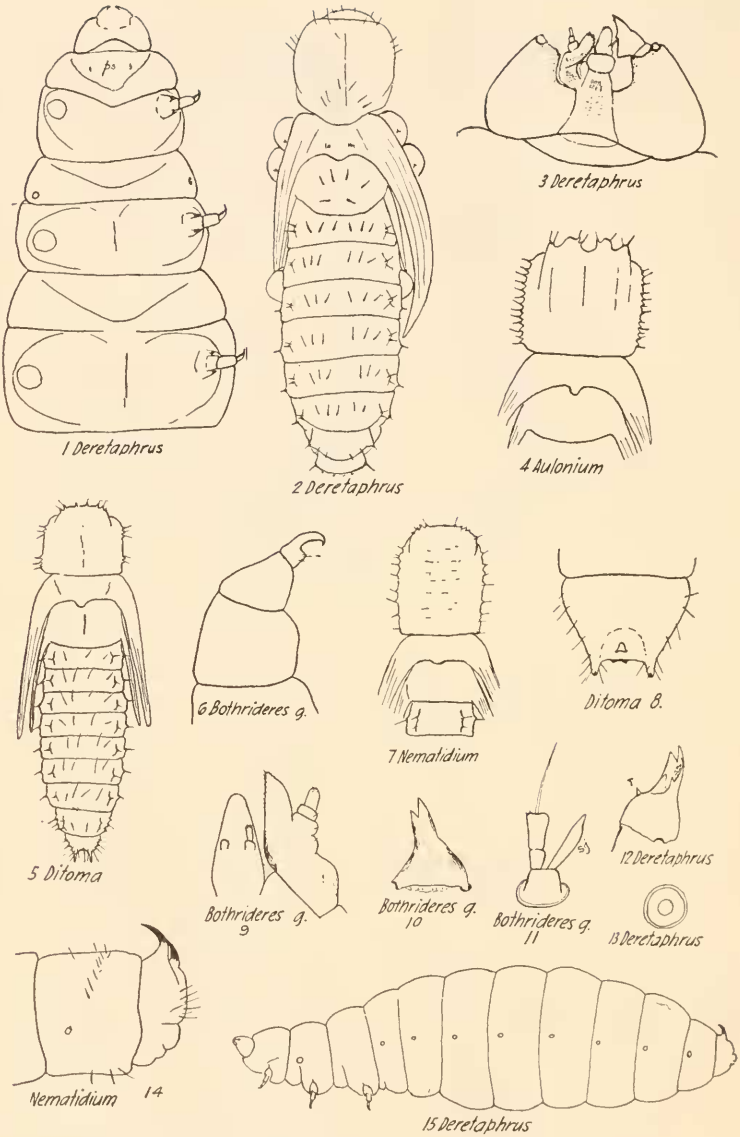
EXPLANATION OF PLATES.

Plate 1.

Fig. 1. *Aulonium tuberculatum*—dorsal view of head.
Fig. 2. *Aulonium tuberculatum*—dorsal view of right mandible.
Fig. 3. *Nematidium filiforme*— dorsal view of right mandible.
Fig. 4. *Aulonium tuberculatum*—ventral view of head.
Fig. 5. *Phloeonemus catenulatus*—mesothoracic spiracle.
Fig. 6. *Synchita fuliginosa*—dorsal view of head.
Fig. 7. *Synchita fuliginosa*—ventral view of head.
Fig. 8. *Synchita fuliginosa*—ventral view of thorax.
Fig. 9. *Phloeonemus catenulatus*—dorsal view of right mandible.
Fig. 10. *Nematidium filiforme*—dorsal view of head.
Fig. 11. *Phloeonemus catenulatus*—dorsal view of ninth abdominal segment.
Fig. 12. *Nematidium filiforme*—ventral view of head.
Fig. 13. *Aulonium tuberculatum*—lateral view of body.
Fig. 14. *Aulonium tuberculatum*—mesothoracic spiracle.



CRAIGHEAD—BIOLOGY OF COLEOPTERA



CRAIGHEAD—BIOLOGY OF COLEOPTERA

Plate 2.

Fig. 1. *Deretaphrus oregonensis*—ventral view of thorax and head.
Fig. 2. *Deretaphrus oregonensis*—dorsal view of pupa.
Fig. 3. *Deretaphrus oregonensis*—ventral view of head.
Fig. 4. *Aulonium tuberculatum*—dorsal view of thorax of pupa.
Fig. 5. *Ditoma crenata*—dorsal view of pupa.
Fig. 6. *Bothrideres geminatus*—leg.
Fig. 7. *Nematidium filiforme*—dorsal view of thorax of pupa.
Fig. 8. *Ditoma crenata*—dorsal view of ninth abdominal segment.
Fig. 9. *Bothrideres geminatus*—labrum and maxillae.
Fig. 10. *Bothrideres geminatus*—right mandible from side.
Fig. 11. *Bothrideres geminatus*—right antennae.
Fig. 12. *Deretaphrus oregonensis*—left mandible from below.
Fig. 13. *Deretaphrus oregonensis*—spiracle.
Fig. 14. *Nematidium filiforme*—lateral view of eighth and ninth abdominal segments.
Fig. 15. *Deretaphrus oregonensis*—lateral view of body.

ABBREVIATIONS.

C, cardo; gu, gula; ha, arm of hypostoma connecting with hypopharynx (hypopharyngeal bracon); l, ligula; ls, labial stipes; m, mentum; pf, palpifer; ps, presternum; r, retinaculum; s, stipes of maxillae; sj, supplementary joint of antennae; ta, tentorial arms.

DISTRICT OF COLUMBIA DIPTERA: ASILIDAE [1]

By W. L. McAtee and Nathan Banks.

The family Asilidae comprises flies which vary in size from small to extremely large. A much-used English name for the group is robber-flies, a most inappropriate term, for which assassin-flies would be a good substitute. The species are uniformly predacious, have a characteristic leggy, grasping appearance and voracious appetites. They prey upon other insects, taking toll from nearly all groups. Some of the larger species are as watchful as hawks, swift in action and correspondingly difficult to capture. Sunny paths and roads are a favorite resort for many of the species; some sit on bare trunks and poles, some on leaves, the tips of dead twigs or blades of grass, and a few in the shade. The different genera and species have quite characteristic habits in this respect, making search for them a source of constant interest to the collector.

[1] For the Syrphidae, see Proc. Biol. Soc. Wash., 29, pp. 173–204, Sept. 22, 1916; and the Tabanidae, Proc. Ent. Soc. Wash., Vol. 20, pp. 188–206. Dec. 1918.